

Anomalous refractive effects at the interface of two-dimensional PCs

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Photonic crystals (PCs) can enable left-handed (backwards wave) propagation when certain conditions are met [1]. Nonetheless, negative refraction at PC interfaces is neither a prerequisite nor a manifestation of backwards wave propagation [2]. We study systematically the refractive behavior of two-dimensional PCs with the Finite Difference Time Domain (FDTD) method [3]. We have identified four distinct cases for which a negatively refracted beam is present. Nonetheless, only in one of these cases the negatively refracted beam is a backwards wave. We analyze the different mechanisms that can lead to a negatively refracted beam with the wave vector diagram formalism. We found that such formalism is general, and always leads to a correct prediction/interpretation of the refracted beam(s). Finally, we study the phase and "rightness" of EM wave propagation in PCs with a low index modulation, and make a comparison with the high-index modulation cases.

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